

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

1. (Currently Amended) An integrated semiconductor manufacturing assembly comprising:

a front-of-line portion comprising a plurality of integrated sub-stations for operating on a first plurality of die-strips on an in-line basis to produce a second plurality of die-strips, wherein a next one of said first plurality of die-strips enters said front-of-line portion as soon as a previous one of said first plurality of die-strips clears said front-of-line portion;

an end-of-line portion coupled by an automatic transfer device to said front-of-line portion and comprising a plurality of integrated sub-stations for operating on said second plurality of die-strips on an in-line basis to produce die-strip components;

an in-line test portion coupled by an automatic transfer device to said end-of-line portion for testing said die-strip components; ~~and~~

a finish portion coupled by an automatic transfer device to said in-line test portion and comprising a plurality of integrated sub-stations operating on tested die-strip components; and

a manufacturing execution system coupled to said front-of-line portion, said end-of-line portion, said in-line test portion and said finish portion for managing said die strips and said die-strip components.

2. (Original) The assembly as described in Claim 1 wherein one of said plurality of sub-stations of said front-of-line portion is an in-line plasma sub-station.

3. (Original) The assembly as described in Claim 1 wherein one of said plurality of sub-stations of said front-of-line portion is a snap cure sub-station.

4. (Original) The assembly as described in Claim 1 wherein said plurality of sub-stations of said front-of-line portion comprise:

an in-line die attach sub-station for attaching dies to a strip to produce said first plurality of die-strips;

an in-line cure sub-station;

a first in-line plasma sub-station;

an in-line wire bond sub-station; and

a second in-line plasma sub-station.

5. (Currently Amended) The assembly as described in Claim 4 wherein said manufacturing execution system comprises ~~further comprising~~ camera systems for performing automated die-strip inspection and quality assurance at said die attach and wire bond sub-stations.

6. (Original) The assembly as described in Claim 1 wherein said plurality of sub-stations of said end-of-line portion comprise:

an in-line mold sub-station;

an in-line post mold cure sub-station;

an in-line solder board attachment sub-station;

an in-line sawing sub-station; and

a sorting sub-station.

7. (Currently Amended) The assembly as described in Claim 6 wherein said manufacturing execution system comprises ~~further comprising~~ camera systems for performing automated product inspection and quality assurance at said mold, solder board attachment and sorting sub-stations.

8. (Original) The assembly as described in Claim 1 wherein said plurality of sub-stations of said finish portion comprise:

- a marking sub-station;
- a final visual inspection sub-station; and
- a tape and reel sub-station.

9. (Original) The assembly as described in Claim 1 wherein said front-of-line portion is coupled to said end-of-line portion to provide said second plurality of die-strips to said end-of-line portion in an in-line fashion.

10. (Original) The assembly as described in Claim 1 wherein said end-of-line portion is coupled to said test portion to automatically provide said die-strip components to said test portion.

11. (Original) The assembly as described in Claim 1 wherein said test portion is coupled to said finish portion to automatically provide said tested die-strip components to said finish portion.

12. (Currently Amended) An integrated semiconductor manufacturing assembly comprising:

- a front-of-line portion comprising a plurality of sub-stations for operating on a plurality of die-strips in an in-line basis commencing with an in-line die attach sub-station and ending with a in-line plasma sub-station, wherein a next one of said plurality of die-strips enters said front-of-line portion as soon as a previous one of said plurality of die-strips clears said front-of-line portion; ~~and~~

- an end-of-line portion automatically receiving processed die-strips from said front-of-line portion in an in-line fashion and comprising a plurality of sub-stations for operating on said processed die-strips in an in-line basis commencing with an in-line mold sub-station and ending

with a sort sub-station, wherein a next one of said processed die-strips enters said end-of-line portion as soon as a previous one of said processed die-strips clears said front-of-line portion;
and

a manufacturing execution system coupled to said front-of-line portion and said end-of-line portion for controlling processing activities of at least one sub-station based upon data from a planning database and a vision camera system.

13. (Original) An assembly as described in Claim 12 further comprising:

an in-line test portion automatically receiving die-strip components output from said in-line sort sub-station and for testing said die-strip components; and

a finish portion coupled to said in-line test portion and comprising a plurality of sub-stations operating on tested die-strip components output from said in-line test portion and commencing with a marking sub-station and ending with a tape and reel sub-station.

14. (Original) The system as described in Claim 12 wherein one of said plurality of sub-stations of said front-of-line portion further comprises another in-line plasma sub-station.

15. (Original) The system as described in Claim 14 wherein one of said plurality of sub-stations of said front-of-line portion is an in-line snap cure substation.

16. (Original) The system as described in Claim 15 wherein one of said plurality of sub-stations of said front-of-line portion is an in-line wire bond substation.

17. (Currently Amended) The system as described in Claim 12 ~~further comprising a~~
wherein said vision camera system is coupled to said manufacturing execution system for performing automated die-strip inspection and quality assurance at said in-line die attach sub-station.

18. (Original) The system as described in Claim 12 wherein said plurality of sub-stations of said end-of-line portion further comprise:

- an in-line post mold cure sub-station coupled to said in-line mold sub-station;
- an in-line solder board attachment sub-station; and
- an in-line sawing sub-station coupled to said sort sub-station.

19. (Currently Amended) The system as described in Claim 18 ~~further comprising~~ wherein said vision camera system is coupled to said manufacturing execution system for performing automated product inspection and quality assurance at said mold, solder board attachment and sorting sub-stations.

20. (Original) The system as described in Claim 13 wherein said plurality of sub-stations of said finish portion further comprise a final visual inspection sub-station coupled between said marking sub-station and said tape and reel sub-station.

21. (Currently Amended) An apparatus for automatically fabricating a semiconductor device comprising:

- (a) a die attach module adapted to attach a plurality of integrated circuit die to a substrate under computer control;
- (b) a wire bonding module adapted to bond wires to both the substrate and the attached die under computer control;
- (c) a molding module adapted to encapsulate wire-bonded die and substrate with a mold material under computer control;
- (d) a singulation module adapted to separate encapsulated, wire-bonded die and substrate under computer control into separated die;
- (e) a testing module adapted to test the separated die under computer control; ~~and~~
- (f) a plurality of transporters adapted to automatically transport: (i) the substrate and the attached die from the die attach module to the wire bonding module, wherein the next substrate

and attached die enter the wire bonding module as soon as a previous substrate and attach die clear the wire bonding module; (ii) the wire-bonded die and substrate from the wire bonding module to the molding module; (iii) the encapsulated, wire-bonded die and substrate from the molding module to the singulation module; and (iv) the separated die from the singulation module to the testing module; and

(g) a manufacturing execution system adapted to control processing activities of said die attach module, said wire bonding module and said singulation module.

22. (Original) The apparatus as described in Claim 21 further comprising (g) an automated machine vision system adapted to inspect at least two of: (i) the substrate and the attached die; (ii) the wire-bonded die and substrate; (iii) the encapsulated, wire-bonded die and substrate; and (iv) the separated die.

23. (Original) The apparatus of Claim 21 wherein said transporters comprise a plurality of conveyors.

24. (Currently Amended) The apparatus of Claim 22 further comprising a marking module adapted to mark the tested die under ~~computer~~ manufacturing execution system control.

25. (Original) The apparatus of Claim 24 wherein the automated machine vision system is further adapted to inspect the marked die.

26. (Original) The apparatus of Claim 24 wherein the transporters are further for automatically transporting the tested die to the marking module.

27. (Currently Amended) The apparatus of Claim 24 further comprising a packaging module adapted to package the tested die under ~~computer~~ manufacturing execution system control to produce packaged die.

28. (Original) The apparatus of Claim 27 wherein the automated machine vision system is further adapted to inspect the packaged die.

29. (Original) The apparatus of Claim 27 wherein the transporters are further for automatically transporting the tested die to the packaging module.

30. (Original) The apparatus of Claim 27 wherein the packaging module comprises a tape and reel module.

31. (Original) The apparatus of Claim 21 further comprising a snap curing module adapted to snap cure an adhesive adapted to attach the plurality of die to the substrate.

32. (Original) The apparatus of Claim 21 further comprising an in-line plasma cleaning module adapted to plasma clean the substrate and attached die.

33. (Original) The apparatus of Claim 21 further comprising an in-line plasma cleaning module adapted to plasma clean the wire-bonded substrate and die.

34. (Original) The apparatus of Claim 21 wherein the singulation module comprises a sawing module.

35. (Original) The apparatus of Claim 21 wherein the substrate comprises an n-by-m matrix array ball grid array (BGA) substrate and wherein n and m each independently being an integer of at least 2.

36. (Currently Amended) The apparatus of Claim 21 further comprising a sawing module adapted to saw wafers under ~~computer~~ manufacturing execution system control to provide said separated die.

37. (Currently Amended) An apparatus comprising:

(a) an in-line die attach module adapted to attach a plurality of ~~integrated circuit~~ die to a substrate under computer control;

(b) an in-line wire bonding module adapted to bond wires to both the substrate and the attached die under computer control;

(c) an in-line molding module adapted to encapsulate the wire-bonded die and substrate with a mold material under computer control;

(d) a plurality of transporters adapted to automatically transport:

(i) the substrate and the attached die from the die attach module to the wire bonding module such that the next substrate and the attached die enter the wire bonding module after a previous substrate and the attached die complete the wire-bonding process, and

(ii) the wire-bonded die and substrate from the wire bonding module to the molding module such that the next wire-bonded die and substrate enter the molding module after a previous wire-bonded die and substrate complete the molding process; and

(e) an automated machine vision system adapted to inspect at least two of: (i) the substrate and the attached die; (ii) the wire-bonded die and substrate; and (iii) the encapsulated, wire-bonded die and substrate; and

(e) a manufacturing execution system adapted to control processing activities of said in-line die attach module, said in-line wire bonding module and said in-line molding module, to provide reject management of each of said plurality of die and to categorize each of said plurality of die.

38. (Original) An apparatus as described in Claim 37 further comprising an in-line plasma module coupled between said die attach module and said wire bonding module.

39. (Original) An apparatus as described in Claim 38 further comprising an in-line snap cure module coupled between said die attach module and said plasma module.

40. (Currently Amended) An apparatus comprising:

(a) a die attach module adapted to attach a plurality of integrated circuit die to a substrate under computer control;

(b) a molding module adapted to encapsulate the substrate and attached die with a mold material under computer control;

(c) a testing module adapted to test the molded substrate and die under computer control;

(d) a plurality of transporters adapted to automatically transport:

(i) the substrate and the attached die from the die attach module to the molding module such that the next substrate and the attached die enter the molding module after a previous substrate and the attached die complete the molding process, and

(ii) the molded die from the molding module to the testing module such that the next molded die enters the testing module after a previous molded die completes the testing process; ~~and~~

(e) an automated machine vision system adapted to inspect at least one of: (i) the substrate and the attached die; and (ii) the molded die and substrate; and

(f) a manufacturing execution system adapted to controlling processing activities of said die attach module, said molding module and said testing module based upon data from a planning database and said automated machine vision system.

41. (Original) An apparatus as described in Claim 40 further comprising an in-line plasma module coupled between said die attach module and said molding module.

42. (Original) An apparatus as described in Claim 41 further comprising an in-line snap cure module coupled between said die attach module and said plasma module.

43. (Currently Amended) An apparatus comprising:

(a) a wire bonding module adapted to bond wires to both a substrate and a plurality of die attached to the substrate under computer control;

(b) a molding module adapted to encapsulate the wire-bonded die and substrate with a mold material under computer control;

(c) a singulation module adapted to separate the encapsulated, wire-bonded die and substrate under computer control into separated die;

(d) a plurality of transporters adapted to automatically transport:

(i) the wire-bonded die and substrate from the wire bonding module to the molding module such that the next wire-bonded die and substrate enter the molding module after a previous wire-bonded die and substrate complete the molding process; and

(ii) the encapsulated, wire-bonded die and substrate from the molding module to the singulation module such that the next encapsulated, wire-bonded die and substrate enter the singulation module after a previous encapsulated, wire-bonded die and substrate complete the singulation process; and

(e) an automated machine vision system adapted to inspect two or more of: (i) the wire-bonded die and substrate; (ii) the encapsulated, wire-bonded die and substrate; and (iii) the separated die; and

(f) a manufacturing execution system adapted to controlling processing activities of said wire bonding module, said molding module and said singulation module based upon data from a planning database and said automated machine vision system.

44. (Original) An apparatus as described in Claim 43 further comprising an in-line plasma module coupled to said wire bonding module.

45. (Original) An apparatus as described in Claim 44 further comprising an in-line snap cure module coupled to said plasma module.

46. (Currently Amended) An apparatus comprising:

(a) an in-line wire bonding module adapted to bond wires to both a substrate and a plurality of die attached to the substrate under computer control;

(b) an in-line molding module adapted to encapsulate the wire-bonded die and substrate with a mold material under computer control;

(c) an in-line testing module adapted to test the separated die under computer control;

(d) a plurality of transporters adapted to automatically transport:

(i) the wire-bonded die and substrate from the wire bonding module to the molding module such that the next wire-bonded die and substrate enters the molding module after a previous wire-bonded die and substrate complete the molding process; and

(ii) the encapsulated, wire-bonded die and substrate from the molding module to the testing module such that the next encapsulated, wire-bonded die and substrate enters the testing module after a previous encapsulated, wire-bonded die and substrate complete the testing module; ~~and~~

(e) an automated machine vision system adapted to inspect at least one of: (i) the wire-bonded die and substrate; and (ii) the encapsulated, wire-bonded die and substrate; and

(f) a manufacturing execution system adapted to controlling processing activities of said in-line wire bonding module, said in-line molding module and said in-line testing module based upon data from a planning database and said automated machine vision system.

47. (Original) An apparatus as described in Claim 46 further comprising an in-line plasma module coupled to said wire bonding module and further comprising an in-line snap cure module coupled to said plasma module.

48. (Currently Amended) An apparatus comprising:

- (a) a molding module adapted to encapsulate a substrate and a plurality of die wire-bonded to the substrate with a mold material under computer control;
- (b) a singulation module adapted to separate the encapsulated, wire-bonded die and substrate under computer control into separated die;
- (c) a testing module adapted to test the separated die under computer control;
- (d) a plurality of transporters adapted to automatically transport:
 - (i) the encapsulated, wire-bonded die and substrate from the molding module to the singulation module such that the next wire-bonded die and substrate enters the molding module after a previous wire-bonded die and substrate complete the singulation process; and
 - (ii) the separated die from the singulation module to the testing module such that the next separated die enters the testing module after a previous separated die completes the testing process; ~~and~~
- (e) an automated machine vision system adapted to inspect at least one of: (i) the encapsulated, wire-bonded die and substrate; and (ii) the separated die; and
- (f) a manufacturing execution system adapted to controlling processing activities of said molding module, said singulation module and said testing module based upon data from a planning database and said automated machine vision system.

49. (Original) An apparatus as described in Claim 48 further comprising an in-line plasma module coupled to said molding module.

50. (New) The assembly as described in Claim 1, wherein said managing said die-strips and said die-strip components comprises reject management.

51. (New) The assembly as described in Claim 1, wherein said managing said die-strips and said die-strip components comprises die categorization.

52. (New) The assembly as described in Claim 1, wherein said managing said die-strips and said die-strip components comprises controlling processing activities of said front-of-line portion, said end-of-line portion, said in-line test portion and said finish portion.